Studies of TOF reconstruction

- TOF used in the search for long-lived massive charged particles (CHAMP)
  - First use of TOF in an analysis
  - Blessed result: Mass of stable stop > 107 GeV
- Background from TOF mismeasurements
  - Mismeasured t_0 (t_0 too small)
  - Mismeasured cand. CHAMP (TOF measurement too large)
- Would like to reduce the rate of measurement error for the next round of the analysis

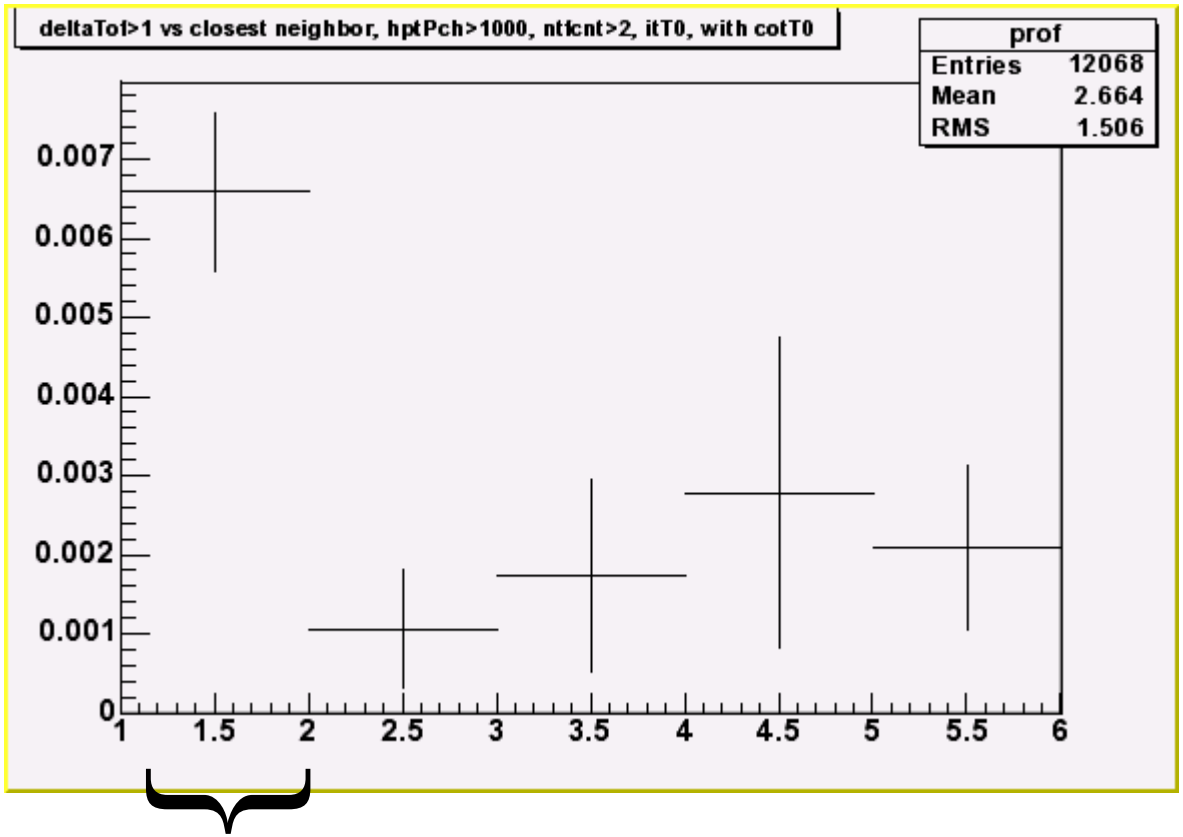
Data used for studies

- Use $W \rightarrow e\nu$ data to study errors in TOF reconstruction
  - Treat high-p_T electron as candidate track
  - Use other tracks in event to calculate t_0
  - Define Δ_{TOF}, tof(meas) - tof(expected) for cand. track.
- Studies with $W \rightarrow e\nu$ data show Δ_{TOF} >1 ns at rate of 0.3% for the winter conference analysis (i.e 1 out of every 300 events has Δ_{TOF} >1 ns)
- Try to understand source of these reconstruction errors. Study seperately the electron track and the t_0 finding

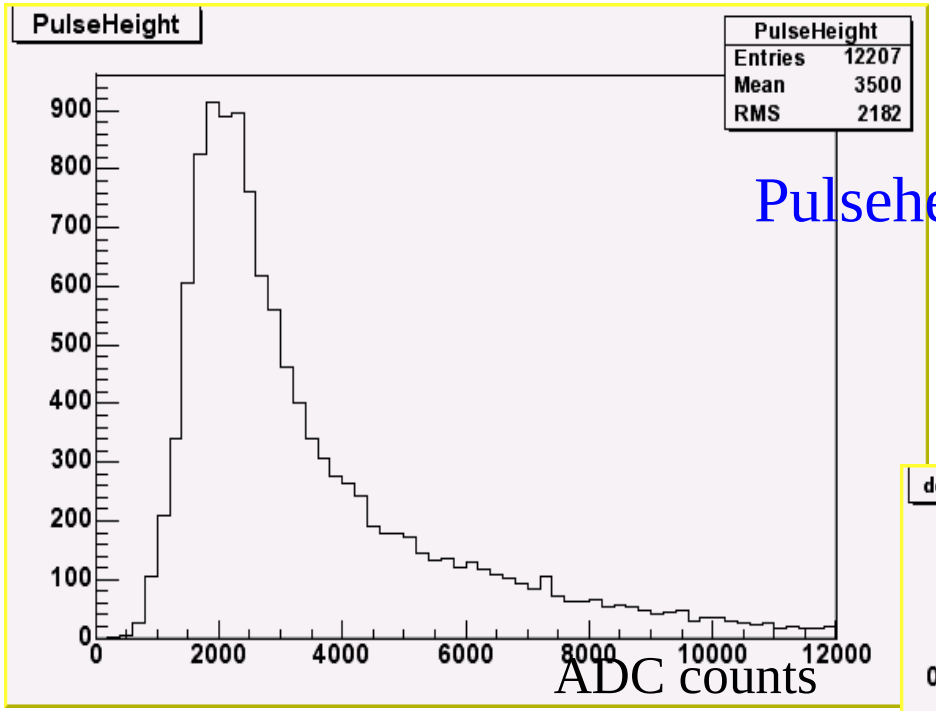
Studies of Electron

- To study TOF reconstruction for high-p_T electron track, need to know that the event t_0 has been measured properly
- Calculate t_0 from TOF using code developed for CHAMP analysis by Rick Snider. Log-likelihood method with:
  - Ability to only use tracks close in Z to high-p_T track
  - Iterative pruning of outliers
  - dE/dx used to modify likelihood in cases of clear ID
- Also have code to calculate t_0 using hits in the COT (code developed by Tom Phillips)
- Select events in which $| t_0 (\text{TOF}) - t_0(\text{COT}) | < 400$ ps

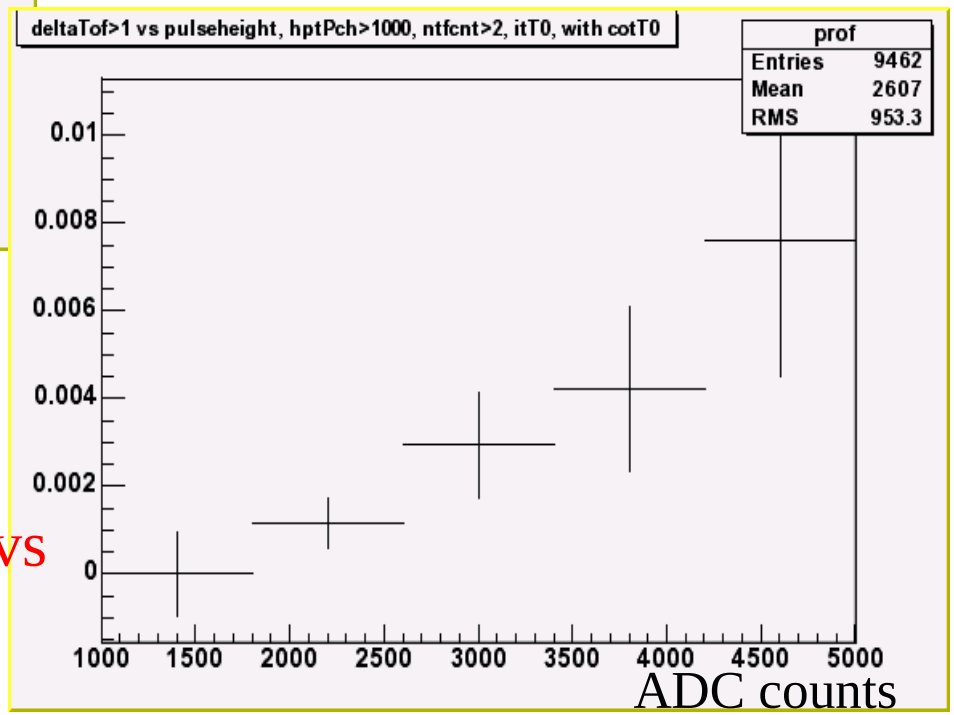
Fraction of events with Δ_{TOF}>1.0 vs number of bars to nearest TOF pulse



This bin: a TOF pulse in at least one of the bars next to the bar intersected by electron

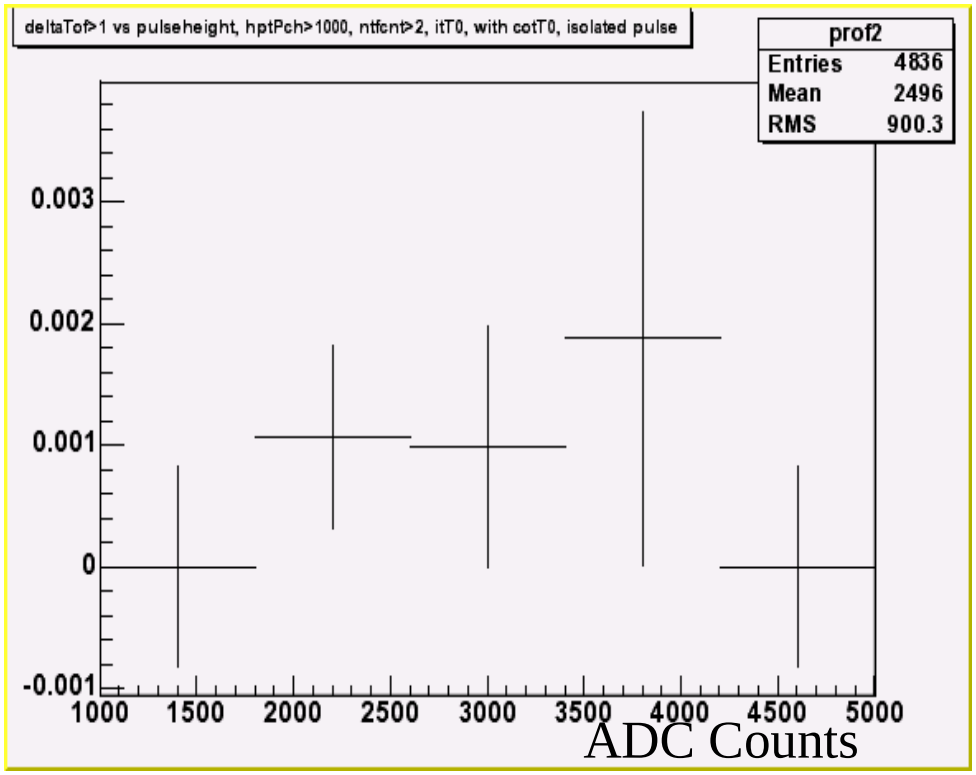


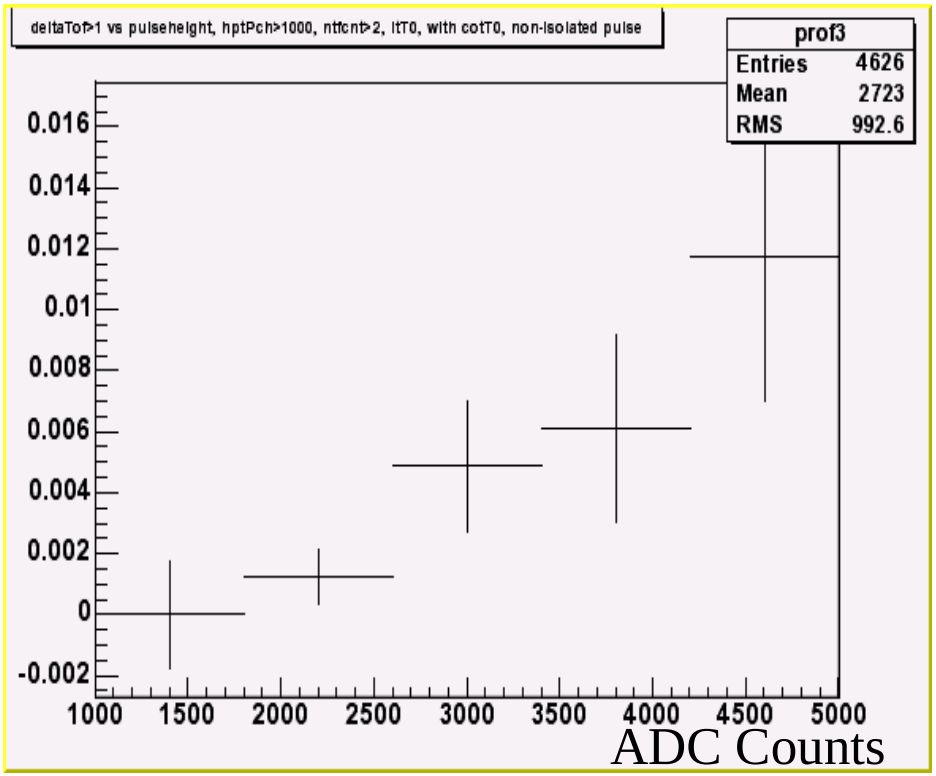
Pulseheight (E+W) of electron



Fraction of events with Δ_{TOF}>1.0 vs E+W pulseheight of electron

Fraction of events with Δ_{TOF}>1.0 vs E+W pulseheight of electron





No TOF pulses in neighboring bars

TOF pulse in at least one neighboring bar

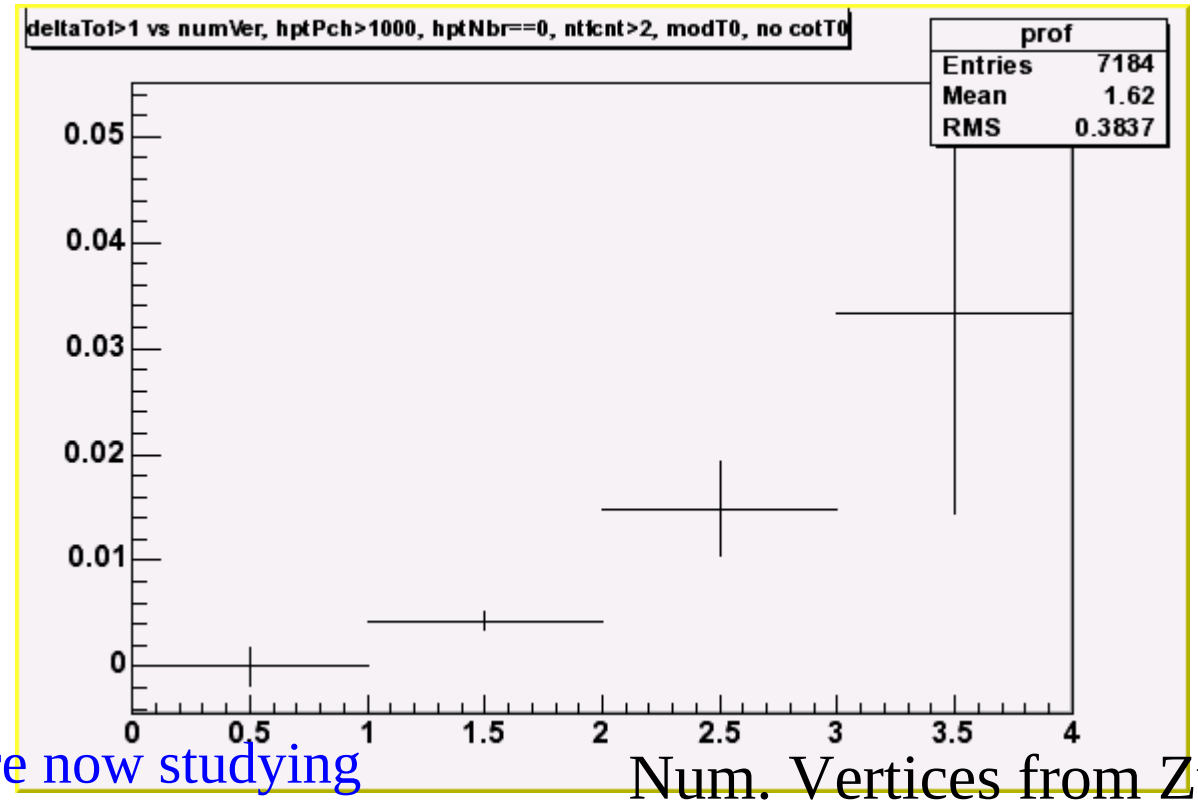
Possible Interpretation

- High-p_T track hits bar, deposits typical amount of charge (~2000 counts, E+W).
- Neutral object or unreconstructed charged object also hits bar. Its charge is also integrated.
- Treated as though single object deposited large amount of charge.
  - Time-walk correction for large amount of charge applied
  - Will always move TOF to larger values

T_0 Studies

- Select events in which the high-p_T track is isolated (no pulses in neighbor bars). This selects events in which the TOF for the electron is measured properly (at level of 0.1%).
- Remove requirement that t_0 from TOF and COT be within 400 ps (since I'm looking for events with t_0 errors)
- Don't use dE/dx or the interative pruning in the t_0 calculation, but still only use tracks close to the electron in Z
- First check: fraction of events with $\Delta_{TOF} > 1$ ns should increase for events with multiple interactions - check this!

Fraction of events with Δ_{TOF}>1.0 vs number of vertices in Z

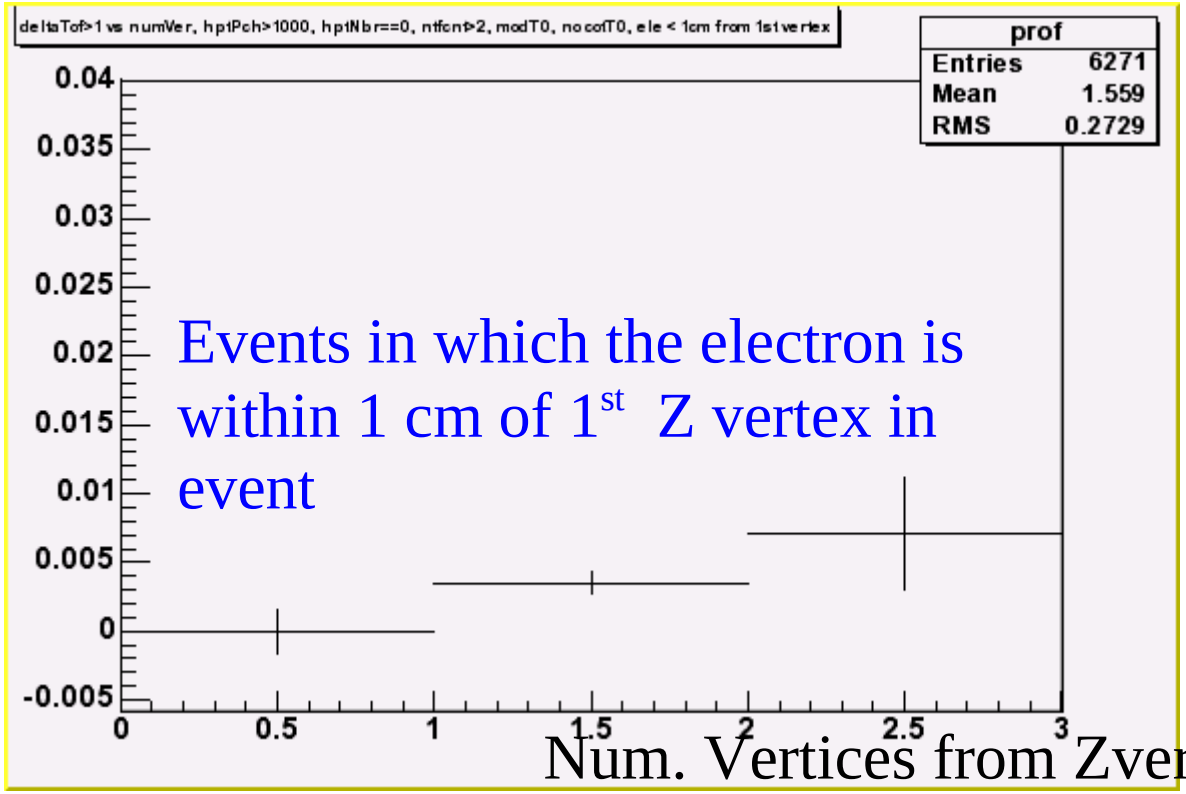


Num. Vertices from ZvertexColl

Remember, we are now studying events in which the t_0 is too small,

presumably because one or more tracks has meaured TOF that is too small

Fraction of events with Δ_{TOF}>1.0 vs number of vertices in Z

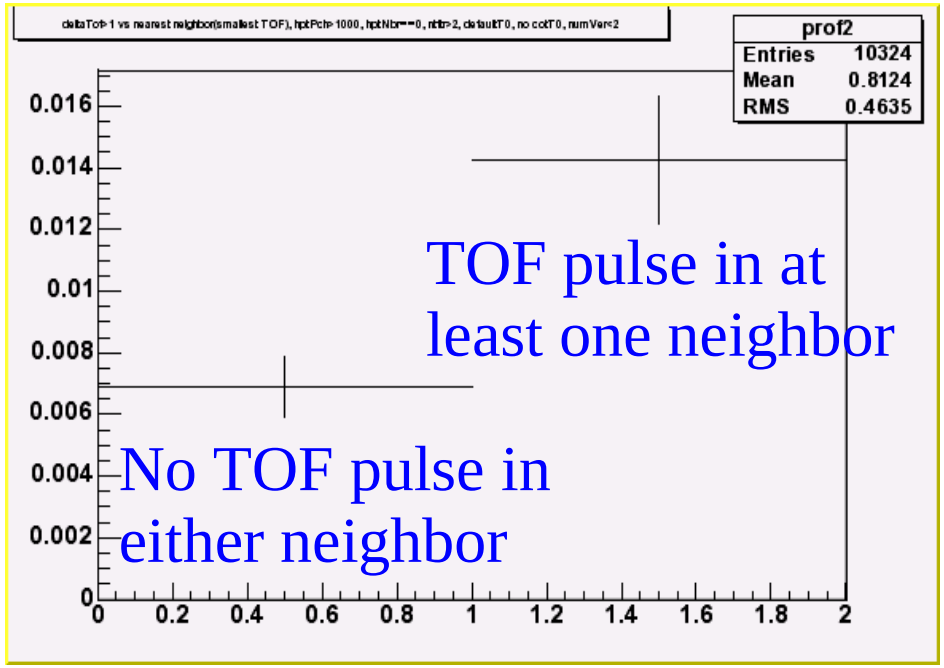


This plot shows the effect of eliminating events in which objects from an earlier interaction spoil the t_0 finding

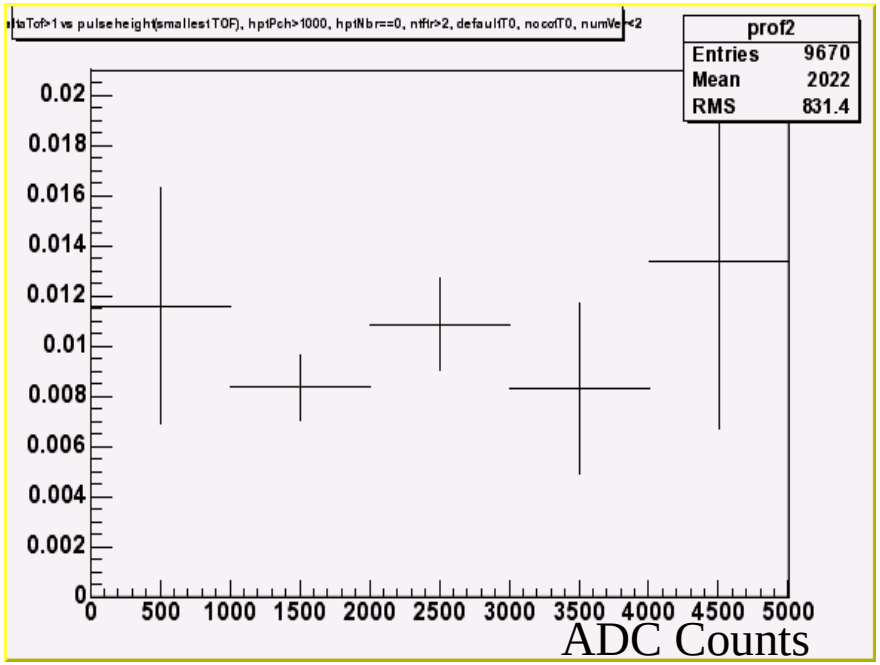
More T_0 Studies

- Now study the hypothesis that a single track with measured TOF smaller than it should be is at least partly responsible for t_0's that are too small
- For this phase of study, use the t_0 from the default TOF reconstruction
- Also require <2 vertices in Z to eliminate effect of multiple interactions
- Study the track in the event with the smallest TOF

Δ_{TOF} vs isolation of track with smallest TOF

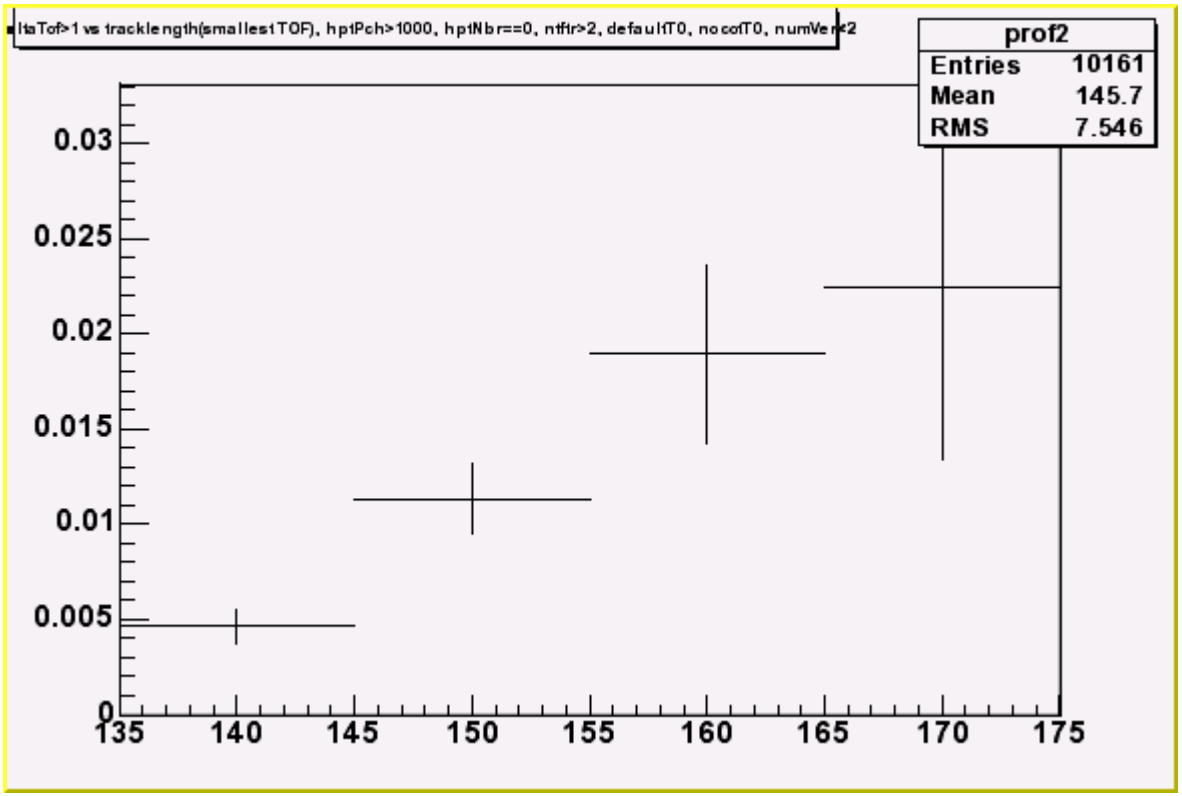


Δ_{TOF} vs pulseheight of track with smallest TOF



This is flat, so we are most likely not seeing an effect due to multiple objects hitting a bar

Δ_{TOF} vs pathlength of track with smallest TOF



Slow moving particle hitting bar well after a neutral object does? Needs further investigation

Possible Interpretation

- Neutral object or unreconstructed charged object hits bar before one of the tracks used to find t0 does
- Charge from this object read out on both East and West. TOF taken from these pulses.